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NOTES ON THE MOVEMENTS OF THE ANDRŒCIUM IN SUNFLOWERS.

BY DR. ASA GRAY.

My attention was called to this subject by some observations made by Professor Meehan, the substance of which is now printed in the "Proceedings of the Academy of Natural Sciences," pp. 200, 201, under date of July 15 of this year. My own study of the subject was necessarily desultory and interrupted, and mainly too late in the season for the most satisfactory investigation. My object in sending this communication to the Academy, at this time, is, in the first place, to thank Mr. Meehan for calling attention to a very obvious fact, which I had entirely overlooked, and which those botanists (such as the late Hermann Müller), who have particularly attended to the adaptations for fertilization in Compositæ, were seemingly not aware of. The fact referred to, is the retraction of the anther-tube in *Helianthus* (and so, presumably, in its near allies), somewhat in the manner of *Centaurea* and the Thistle tribe generally. In the second place, I wish to maintain that this retraction in the sunflower is the result of automatic or irritable shortening of the filaments, and not of the "elasticity of the filaments." In other words, that those organs act in Sunflowers as they have for a long time been known to do in the Thistle tribe, but with some difference. If I rightly understand Professor Meehan's account, he supposes that the anther-tube is carried up to its full height by the elongation of the style within, its stigmatic apex pushing against the conniving anther-appendages which close the orifice of the tube, and so stretching the filaments; and that the elastic shortening of the filaments pulls down the anther-tube when the style has overcome this obstacle and protruded. If this were so, the stamen-tube should be drawn down at once upon overcoming the resistance. It is easy to test this, by snipping off the anther-tips by sharp scissors. But when I did this, no retraction followed. Moreover, on splitting down anther-tubes at various stages of their growth, I found that only at the last, and after the anther-tube had attained its full height, was the tip of the style in contact with the anther-tips. Prof. Meehan's idea that "the extension of the staminal tube is evidently mechanical, and is due solely to the upward growth of the stigma, which, partly it seems by the incurved points of the stamens, and partly perhaps by the expansion of the arms of the pistil, is able to carry up the tube with it," so that when the resistance is removed, " the elastic stamens [filaments] draw the tube down again," must therefore be given up. The expansion of the arms of the style is not concerned in the process, for this does not commence until after complete protrusion.

As the filaments in the Thistle tribe are sensitive to the touch, in some Centaureas strikingly so; as these are not stretched in *Centaurea*, but are usually bowed outwardly, and as they contract upon the touch of a bristle or of a visiting insect, the first question is whether the same may be the case, in some degree, in Sunflowers. My essays to determine this were made too late in the season to be decisive. But in some flowers, on touching two adjacent filaments with a bristle thrust into one side of the corolla, the column moved promptly toward that side, moving through fifteen or twenty minutes of arc, very much as it will in a *Centaurea.* I did not succeed in causing the five filaments to act together, so as to produce any observable retraction. That this retraction normally takes place without extraneous irritation, is certain, commencing and commonly being completed on the second day after full anthesis; and equally in flowers shielded from the visits of insects.

In Sunflower-heads taken into a room and kept from bees, the pollen, pushed out of the tube through the chinks between the anther-tips, or later borne on the brush of the (as yet) unopened style-branches, is borne aloft, exposed to the humblebees which in the garden freely visit them. Prof. Meehan states that " honey-gatherers seldom resort to them," but I find that in our grounds these were much the most frequent visitors. These were passing from head to head and from plant to plant, inserting their proboscis into the corolla-tubes in succession, beginning at the circumference with the older flowers having expanded and receptive stigmas, and proceeding to the pollen-loaded ones within. It is easy to see that pollen is abundantly transported from one head and one plant to another, and that it is carried from flowers which could not possibly be self-fertilized until the next day, and unlikely to be so then, to those the expanded stigmas of which are only then receptive. Prof. Meehan " may say emphatically that these arrangements favor self-fertilization," but that is not the conclusion which I should draw from his own illustrations any more than from my own.